

Applicant: Wasserscheid et al.  
Filing Date: March 11, 2004

Amendments to the Claims

Docket No. VSKW-1

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## Claims

We claim the following:

- 1) (Canceled)
- 2) (Currently Amended) A process for ~~using a~~ the compound of the Formula 1 ~~in a process~~,

(cation)(R'SO<sub>4</sub>)

Formula 1

comprising the step of: employing the compound as a solvent, or solvent additive in a chemical process; employing the compound as an extraction solvent for a material separation; or employing the compound as a heat carrier, or heat carrier additive in a heat exchange unit, wherein:

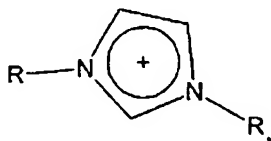
R' is selected from the group consisting of a linear or branched, saturated or unsaturated, aliphatic or alicyclic, functionalized or non-functionalized alkyl radical with 3-36 carbon atoms, wherein R' is optionally functionalized with one or more X groups; X is selected from the group consisting of an -OH, -OR'', -COOH, -COOR'', -NH<sub>2</sub>, -SO<sub>4</sub>, -F, -Cl, -Br, -I or -CN; and R'' is selected from the group consisting of a branched or linear hydrocarbon chain with 1 - 12 carbon atoms;

the compound has a melting point of less than 100° C; and

the cation is a nitrogen-containing cation selected from the group consisting of a quaternary ammonium cation, an imidazolium cation, a pyridinium cation, a pyrazolium cation, a phosphonium and a triazolium cation.

- 3) (Currently Amended) The ~~method~~ process of claim 2, wherein the cation is selected from the group consisting of:

- a) quaternary ammonium cation with the general formula (NR<sub>1</sub>R<sub>2</sub>R<sub>3</sub>R)<sup>+</sup>;
- b) phosphonium cation with the general formula (PR<sub>1</sub>R<sub>2</sub>R<sub>3</sub>R)<sup>+</sup>;
- c) imidazolium cation with the general formula



in which the imidazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group;

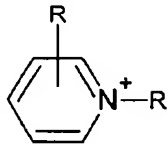
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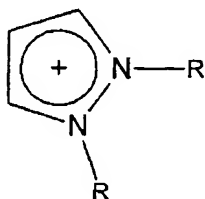
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d) pyridinium cation with the general formula



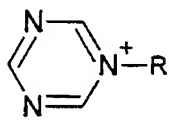
in which the pyridine core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group;

e) pyrazolium cation with the general formula



in which the pyrazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group; and

f) triazolium cation with the general formula



in which the triazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group; wherein

g) the radicals R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> are selected independently at each occurrence from the group consisting of:

- i) hydrogen;
- ii) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;
- iii) heteroaryl groups, heteroaryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 3 to 8 carbon atoms in the heteroaryl radical and at least one heteroatom selected from N, O and S which is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl groups and/or

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halogen atoms;

- iv) aryl, aryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or a halogen atom; and  
h) the radical R is selected from the group consisting of:

- 5 i) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;
- ii) heteroaryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 3 to 8 carbon atoms in the aryl radical and at least one heteroatom selected from N, O and S, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or halogen atom; and
- 10 iii) aryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or halogen atom.
- 4) (Currently Amended) The ~~method~~ process of claim 2, wherein the anion has an empirical formula selected from the group consisting of C<sub>4</sub>H<sub>9</sub>SO<sub>4</sub>, C<sub>8</sub>H<sub>17</sub>SO<sub>4</sub> or C<sub>12</sub>H<sub>25</sub>SO<sub>4</sub>.
- 5) (Currently Amended) The ~~method~~ process of claim 2, wherein the compound of the Formula 1 has a melting point of less than 75° C.
- 15 6) (Currently Amended) The ~~method~~ process of claim 2, wherein the compound of the Formula 1 has a melting point of less than 50° C.
- 7) (Currently Amended) The ~~method~~ process of claim 2, wherein (R'SO<sub>4</sub>) is an alkyl sulfate ester, wherein the alkyl moiety is selected from the group consisting of butyl, octyl, 2-ethylhexyl, and dodecyl; and the ~~method~~ process comprises the step of: employing the compound as a solvent, solvent additive, ~~or in a chemical process; employing the compound as an extraction solvent in a material separation; or employing the compound as a heat carrier, or heat carrier additive in a heat exchange unit; or employing the compound as a phase transfer catalyst.~~
- 20 8) (Currently Amended) The ~~method~~ process of claim 7, wherein the cation is a nitrogen containing cation selected from the group consisting of 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium butyl, 1-hexyl-3-methylimidazolium, 1-octyl-3-methylimidazolium, 1-decyl-3-methylimidazolium, 1-dodecyl-3-methylimidazolium, 1-butyl-pyridinium, trimethyldecylammonium, trioctylmethylammonium,
- 25 trimethyldecylammonium, and trihexyltetradecylphosphonium.
- 30 9) (Currently Amended) The ~~method~~ process of claim 2, wherein the cation is a nitrogen

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containing cation selected from the group consisting of 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium butyl, 1-hexyl-3-methylimidazolium, 1-octyl-3-methylimidazolium, 1-decyl-3-methylimidazolium, 1-dodecyl-3-methylimidazolium, 1-butyl-pyridinium, trimethyldecylammonium, trioctylmethylammonium, trimethyldecylammonium, and trihexyltetradecylphosphonium; and the method process comprises the step of: employing the compound as a solvent or, solvent additive, or in a chemical process; employing the compound as an extraction solvent for a material separation; or employing the compound as a heat carrier, or heat carrier additive in a heat exchange unit; or employing the compound as a phase transfer catalyst.

10 10) (Currently Amended) The method process of claim 2, wherein the ~~compound of the Formula 1 is used in process~~ is a reaction catalyzed by a transition metal; and the method process further comprises the step of: employing the compound as a solvent or, solvent additive, or in a chemical process; employing the compound as an extraction solvent for a material separation; or employing the compound as a heat carrier, or heat carrier additive in a heat exchange unit; or employing the compound as a phase transfer catalyst.

11) (Currently Amended) The method process of claim 10, wherein the ~~compound of the Formula 1 is used in the chemical process~~ is selected from the group consisting of a hydroformylation reaction, a hydrogenation reaction, oligomerization reaction, esterification reaction, isomerization reaction or and amide bond-forming reaction.

12) (Currently Amended) The method process of claim 2, wherein the ~~compound of the Formula 1 is used in chemical process~~ is a reaction catalyzed by an enzyme or biocatalyst; and the method process further comprises the step of: employing the compound as a solvent, or solvent additive or in a chemical process; or employing the compound as an extraction solvent for a material separation; employing the compound as a heat carrier, or heat carrier additive in a heat exchange unit; or employing the compound as a phase transfer catalyst.

13) (Currently Amended) The method process of claim 12, wherein the ~~compound of the Formula 1 is used in chemical process~~ is an oligomerization reaction, C-C bond-forming reaction, esterification reaction, isomerization reaction, or amide bond-forming reaction.

14) (Currently Amended) The method process of claim 2, wherein the compound of the Formula 1 is substantially hydrolytically stable in neutral aqueous solution (pH = 7) up to 80° C.

15) (Currently Amended) The method process of claim 2, wherein the compound of the Formula

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1 has a melting point of less than 25° C.

16) (Currently Amended) The ~~method~~ process of claim 2, wherein the compound is selected from the group consisting of:

- a) 1-ethyl-3-methylimidazolium butyl sulfate;
- 5 b) 1-ethyl-3-methylimidazolium octyl sulfate;
- c) 1-ethyl-3-methylimidazolium 2-ethylhexyl sulfate;
- d) 1-ethyl-3-methylimidazolium dodecyl sulfate;
- e) 1-butyl-3-methylimidazolium butyl sulfate;
- f) 1-butyl-3-methylimidazolium octyl sulfate;
- 10 g) 1-butyl-3-methylimidazolium 2-ethylhexyl sulfate;
- h) 1-butyl-3-methylimidazolium dodecyl sulfate;
- i) 1-hexyl-3-methylimidazolium butyl sulfate;
- j) 1-hexyl-3-methylimidazolium octyl sulfate;
- k) 1-hexyl-3-methylimidazolium 2-ethylhexyl sulfate;
- 15 l) 1-hexyl-3-methylimidazolium dodecyl sulfate;
- m) 1-octyl-3-methylimidazolium butyl sulfate;
- n) 1-octyl-3-methylimidazolium octyl sulfate;
- o) 1-octyl-3-methylimidazolium 2-ethylhexyl sulfate;
- p) 1-octyl-3-methylimidazolium dodecyl sulfate;
- 20 q) 1-decyl-3-methylimidazolium butyl sulfate;
- r) 1-decyl-3-methylimidazolium octyl sulfate;
- s) 1-decyl-3-methylimidazolium 2-ethylhexyl sulfate;
- t) 1-decyl-3-methylimidazolium dodecyl sulfate;
- u) 1-dodecyl-3-methylimidazolium butyl sulfate;
- 25 v) 1-dodecyl-3-methylimidazolium octyl sulfate;
- w) 1-dodecyl-3-methylimidazolium 2-ethylhexyl sulfate;
- x) 1-dodecyl-3-methylimidazolium dodecyl sulfate;
- y) 1-butyl-pyridinium butyl sulfate;
- z) 1-butyl-pyridinium octyl sulfate;
- 30 aa) 1-butyl-pyridinium 2-ethylhexyl sulfate;
- bb) 1-butyl-pyridinium dodecyl sulfate;

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- cc) trimethyldecylammonium butyl sulfate;
- dd) trimethyldecylammonium 2-ethylhexyl sulfate;
- ee) trioctylmethylammonium butyl sulfate;
- ff) trioctylmethylammonium octyl sulfate;
- 5 gg) trioctylmethylammonium 2-ethylhexyl sulfate;
- hh) trioctylmethylammonium dodecyl sulfate;
- ii) trimethyldecylammonium butyl sulfate;
- jj) trimethyldecylammonium octyl sulfate;
- kk) trihexyltetradecylphosphonium butyl sulfate;
- 10 ll) trihexyltetradecylphosphonium octyl sulfate;
- mm) trihexyltetradecylphosphonium 2-ethylhexyl sulfate;
- nn) trihexyltetradecylphosphonium dodecyl sulfate; and the method process comprises the

step of: employing the compound as a solvent or solvent additive, ~~or in a chemical~~  
process; employing the compound as an extraction solvent for a material separation; or  
 15 employing the compound as a heat carrier, or heat carrier additive in a heat exchange  
unit; or employing the compound as a phase transfer catalyst.

17) (Currently Amended) A ~~method process for the of using~~ a compound of the Formula 1 ~~in a~~  
~~process~~

(cation)(R'SO<sub>4</sub>)  
 Formula 1

20 comprising the step of: employing the compound as a solvent, or solvent additive in a  
 chemical process; employing the compound as an extraction solvent for a material separation; or  
 employing the compound as a heat carrier, or heat carrier additive in a heat exchange unit,  
 wherein:

25 R' is selected from the group consisting of a linear or branched, saturated or unsaturated,  
 aliphatic or alicyclic, functionalized or non-functionalized alkyl radical with 3-36 carbon atoms,  
 wherein R' is optionally functionalized with one or more X groups; X is selected from the group  
 consisting of an -OH, -OR'', -COOH, -COOR'', -NH<sub>2</sub>, -SO<sub>4</sub>, -F, -Cl, -Br, -I or -CN; and R'' is  
 selected from the group consisting of a branched or linear hydrocarbon chain with 1 - 12 carbon  
 30 atoms;

the compound has a melting point of less than 100° C;

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the cation is a nitrogen-containing cation selected from the group consisting of a quaternary ammonium cation, an imidazolium cation, a pyridinium cation, a pyrazolium cation, a phosphonium and a triazolium cation;

the compound of the Formula 1 is substantially hydrolytically stable in neutral aqueous solution (pH = 7) up to 80° C.

18) (Currently Amended) The ~~method~~ process of claim 17, wherein (R'SO<sub>4</sub>) has an empirical formula selected from the group consisting of C<sub>4</sub>H<sub>9</sub>SO<sub>4</sub>, C<sub>8</sub>H<sub>17</sub>SO<sub>4</sub> or C<sub>12</sub>H<sub>25</sub>SO<sub>4</sub>, and; the ~~method~~ process comprises the step of: employing the compound as a solvent, solvent additive ~~, or in a chemical process; employing the compound as an~~ extraction solvent for a material separation; ~~or employing the compound as a heat carrier, or heat carrier additive in a heat exchange unit~~; or employing the compound as a phase transfer catalyst.

19) (Currently Amended) A ~~method~~ process for the use of a compound of the Formula 1 ~~in a process~~

(cation)(R'SO<sub>4</sub>)  
Formula 1

comprising the step of: employing the compound as a solvent, or solvent additive in a chemical process; employing the compound as an extraction solvent for a material separation; or employing the compound as a heat carrier, or heat carrier additive in a heat exchange unit, wherein:

- a) (R'SO<sub>4</sub>) is an alkyl sulfate ester, wherein the alkyl moiety is selected from the group consisting of butyl, octyl, 2-ethylhexyl, and dodecyl;
- b) the cation is a nitrogen containing cation selected from the group consisting of 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium butyl, 1-hexyl-3-methylimidazolium, 1-octyl-3-methylimidazolium, 1-decyl-3-methylimidazolium, 1-dodecyl-3-methylimidazolium, 1-butyl-pyridinium, trimethyldecylammonium, trioctylmethylammonium, trimethyldecylammonium, and trihexyltetradecylphosphonium;
- c) the compound has a melting point of less than 100° C. and
- d) the compound of the Formula 1 is substantially hydrolytically stable in neutral aqueous solution (pH = 7) up to 80° C.

20) (Currently Amended) The ~~method~~ process of claim 19, wherein the process is a reaction

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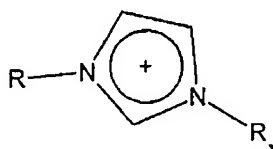
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catalyzed by a transition metal, and the reaction is a hydroformylation reaction, oligomerization reaction, esterification reaction, isomerization reaction or amide bond-forming reaction.

21) (Currently Amended) The ~~method~~ process of claim 19, wherein the process is a reaction catalyzed by an enzyme or biocatalyst, and the reaction is an oligomerization reaction, C-C bond-forming reaction, esterification reaction, isomerization reaction, or amide bond-forming reaction.

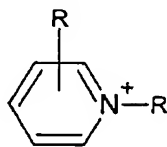
22) (Currently Amended) The ~~method~~ process of claim 18, wherein the cation is selected from the group consisting of:

- a) quaternary ammonium cation with the general formula  $(NR_1R_2R_3R)^+$ ;
- b) phosphonium cation with the general formula  $(PR_1R_2R_3R)^+$ ;
- c) imidazolium cation with the general formula



in which the imidazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group;

- d) pyridinium cation with the general formula



in which the pyridine core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group;

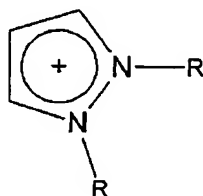
- e) pyrazolium cation with the general formula

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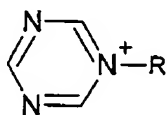
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in which the pyrazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group; and

5 f) triazolium cation with the general formula



in which the triazole core is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl group, C<sub>1</sub>-C<sub>6</sub> alkoxy group, C<sub>1</sub>-C<sub>6</sub> aminoalkyl group, C<sub>5</sub>-C<sub>12</sub> aryl group or C<sub>5</sub>-C<sub>12</sub>-aryl-C<sub>1</sub>-C<sub>6</sub> alkyl group; wherein

10 g) the radicals R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> are selected independently at each occurrence from the group consisting of:

i) hydrogen;

ii) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;

15 iii) heteroaryl groups, heteroaryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 3 to 8 carbon atoms in the heteroaryl radical and at least one heteroatom selected from N, O and S which is optionally substituted with at least one group selected from C<sub>1</sub>-C<sub>6</sub> alkyl groups and/or halogen atoms;

20 iv) aryl, aryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or a halogen atom; and

h) the radical R is selected from the group consisting of:

i) linear or branched, saturated or unsaturated, aliphatic or alicyclic alkyl groups with 1 to 20 carbon atoms;

25 ii) heteroaryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 3 to 8 carbon atoms in the aryl radical and at least one heteroatom selected from N, O and S, which is optionally substituted with at least

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one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or halogen atom; and

iii) aryl-C<sub>1</sub>-C<sub>6</sub> alkyl groups with 5 to 12 carbon atoms in the aryl radical, which is optionally substituted with at least one C<sub>1</sub>-C<sub>6</sub> alkyl group and/or halogen atom.